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NATIONAL DAM SAFETY PROGRAM. MOTTS RUN DAM (VA-17704), RAPPAHAN--ETC(U)
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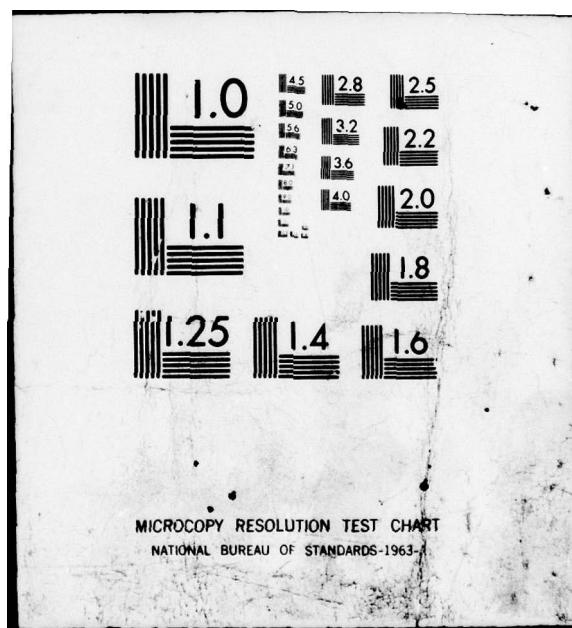
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RAPPAHANNOCK RIVER BASIN

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Name Of Dam: Motts Run

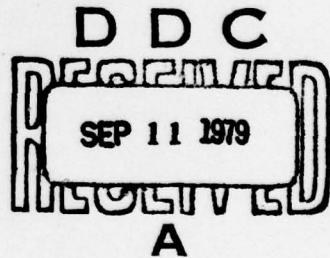
Location: Spotsylvania County, State of Virginia

Inventory Number: VA 17704

LEVEL

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

AD A 073 646



MARCH 1979

PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: MOTTS RUN

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NATIONAL DAM SAFETY PROGRAM

Name of Dam: Motts Run
State: Virginia
County: Spotsylvania
Stream: Motts Run
Date of Inspection: 30 November 1978

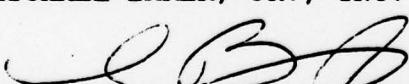
BRIEF ASSESSMENT OF DAM

Motts Run Dam is an earth dam approximately 96 feet high and 650 feet long. The dam is owned and operated by the City of Fredericksburg, Virginia and was designed by Martin, Clifford and Associates. The visual inspection and review of as-built drawings indicate no serious deficiencies requiring immediate attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, it has been determined that the dam would be overtopped for all floods exceeding 96 percent of the Probable Maximum Flood. The spillway is therefore adjudged as inadequate but not seriously inadequate. A stability analysis was not available. However, no evidence of distress due to slope stability problems or seepage was observed. All gate stems on the riser are severely bent rendering the water supply gates and reservoir drain partially inoperable. Repairs are scheduled to be completed in the near future. The construction joint between the riser and transition sections has several leaks which should be repaired.

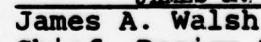
Recommended remedial measures to be scheduled as part of annual maintenance program are to: remove large debris from the reservoir area; fill and reseed erosion gullies and bare areas on the downstream embankment; and remove trees in the emergency spillway, on the embankment, and along the downstream channel.

MICHAEL BAKER, JR., INC.

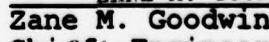

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer



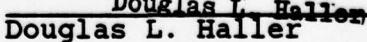
SUBMITTED: Original signed by
JAMES A. WALSH


James A. Walsh
Chief, Design Branch

RECOMMENDED: Original signed by
ZANE M. GOODWIN


Zane M. Goodwin
Chief Engineering

APPROVED: Douglas L. Haller


Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: MAR 13 1979

NAME OF DAM: MOTTS RUN



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: MOTTS RUN ID# VA 17704

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: Motts Run Dam is a homogeneous earthfill dam approximately 96 feet high and 650 feet long. Side slopes on the upstream and downstream embankment are 4 horizontal to 1 vertical (4:1). Seepage control is provided by a filter drain, rock toe, and cutoff trench.

The principal spillway is a drop-inlet type concrete structure consisting of a reinforced concrete riser, a 48 inch diameter reinforced concrete outlet pipe, and an impact basin with a baffle wall and end sill.

A 400 foot wide, vegetated, side-channel emergency spillway is located outside the right abutment of the dam. The approach channel slopes very gradually to a level section about 400 feet long with a crest elevation of 156.0 feet M.S.L. The emergency spillway discharges down a slope of about 4 percent.

NAME OF DAM: MOTTS RUN

The filter drain extends from the rock toe into the embankment for about 250 feet at a depth of 3 feet. The filter material is located about 300 feet along the embankment and on either side of the outlet pipe. The limits of the filter drain can be seen on Plate 1.

The reservoir is used for flood control and water supply. There are two 2.5 by 5.5 foot openings on the two sides of the riser used to maintain normal pool with crest elevations at 150.0 feet M.S.L. Invert elevations of the three water supply gates are 100.0, 120.0, and 140.0 feet M.S.L. The reservoir drain is located on the upstream side of the riser with an invert elevation of 76.0 feet M.S.L. The plan and typical sections of the dam are shown on Plates 1, 2, and 3.

1.2.2 Location: Motts Run Dam is located on Motts Run approximately 1000 feet upstream of its confluence with the Rappahannock River and about 3 miles due west of the City of Fredericksburg, Spotsylvania County, Virginia.

1.2.3 Size Classification: The maximum height of the dam is 96 feet, and the reservoir storage capacity to the top of the dam elevation is 6906 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: Due to the proximity of the City of Fredericksburg, located about 4 miles downstream along the Rappahannock River with a population of 15,000, the dam is considered in the "high" hazard category as defined by Section 2.1.2 of the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned, operated, and maintained by the City of Fredericksburg, Spotsylvania County, Virginia.

1.2.6 Purpose of Dam: The dam is used for water supply for the City of Fredericksburg and for flood control within the Rappahannock River Basin.

NAME OF DAM: MOTTS RUN

1.2.7 Design and Construction History: The existing facility was designed for the owner by Martin, Clifford and Associates of Stafford, Virginia. Moore, Kelly and Reddish, Inc. of Orange, Virginia was the contractor. The dam was completed in June 1971.

1.2.8 Normal Operational Procedures: With the exception of water supply, operation of the reservoir is automatic. Normal pool is maintained by two 2.5 by 5.5 foot openings on the two sides of the riser with crest elevations of 150.0 feet M.S.L. Three water supply gates, located on the sides of the riser at elevations 100.0, 120.0, and 140.0 feet M.S.L. can be used to drain water from different reservoir depths. Excess flows are diverted past the dam through the emergency spillway with a crest elevation of 156.0 feet M.S.L. The reservoir drain with an invert elevation of 76.0 feet M.S.L. can be used to dewater the reservoir.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area upstream of Motts Run Dam is 10.3 square miles.

1.3.2 Discharge at Dam Site: The maximum flow at the dam site through the spillway is unknown.

Principal Spillway:
Pool level at emergency
spillway crest. 420 c.f.s.
Pool level at top of dam. . . . 442 c.f.s.

Emergency Spillway:
Pool level at top of dam. . . 23,200 c.f.s.

NAME OF DAM: MOTTS RUN

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Area acres	Reservoir Capacity		
			Acre- feet	Watershed inches	Length feet
Top of dam	165.0	213	6906	12.6	11,700
Maximum pool, design surcharge	162.0	202	6284	11.4	11,000
Emergency spillway crest	156.0	180	5138	9.4	9700
Principal spillway crest	150.0	160	4119	7.5	8300
Streambed at centerline of dam	72.8	-	-	-	-

NAME OF DAM: MOTTS RUN

SECTION 2 - ENGINEERING DATA

- 2.1 Design: Design information available for review was limited to as-built drawings, which were borrowed from the City of Fredericksburg Engineer's Office. The as-built drawings included plan and typical sections of the dam, boring locations, structural details, outlet details, emergency spillway sections, and topography of the reservoir area. No boring logs, stability calculations, soil reports, or hydrologic/hydraulic calculations were available for review. Plan and typical sections of the dam are included as Plates 1, 2, and 3 in Appendix I. A report on the concrete riser by Hayes, Seay, Mattern and Mattern in November 1977 is included as Appendix V.
- 2.2 Construction: The dam, constructed by Moore, Kelly and Reddish, Inc.; was completed in June 1971. The concrete structures were built by a subcontractor, Bailey and Associates. Construction photos, reports, and other data were not available for this report.
- 2.3 Operation: Information about the operation of the dam and facilities was obtained from the office of the City Engineer. No detailed records of operation were available for review. Three gates used for water supply are located on the riser. Water supply is provided by direct outflow into the Rappahannock River to the City of Fredericksburg's water supply. A fourth gate at the base of the riser can be used to drain the reservoir.
- 2.4 Evaluation
 - 2.4.1 Design: The as-built drawings were satisfactory for background information concerning the general construction features of the structures.
 - 2.4.2 Construction: An evaluation of construction techniques cannot be made because of the lack of sufficient information. However, the as-built drawings do indicate modifications and changes made during construction.
 - 2.4.3 Operation: The gates should be repaired and returned to proper operation without delay.

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SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field investigation was made on 30 November 1978. No unusual weather conditions were experienced and the lake was about 25 feet below normal pool elevation (the reservoir was being drawn down to make repairs to the bent gate stems). The embankment and the appurtenant structures were found to be in good condition and do not require immediate remedial action.

3.1.2 Dam: The embankment was in good overall condition. Some erosion resulting from surface runoff was observed in several gullies and in a path on the downstream slope of the embankment. Future erosion should be prevented by placement of fill and topsoil, and the area should be seeded. Small trees are growing at the junction of the embankment and the abutment, and along the toe of the dam. Scattered driftwood was observed along the shoreline and debris was observed on the embankment.

There was no noticeable seepage from the embankment. Approximately 0.5 g.p.m. flows from a 12 inch drainpipe which is adjacent to the outlet of the principal spillway. A trace of flow is emitted from the other drainpipe. The pipes remove the water from the granular filter drain in the bottom of the embankment near the downstream toe.

3.1.3 Appurtenant Structures: The stems of the water supply gates and pond drain on the riser are severely bent and partially inoperable (see Photo 1). The outlet structure is in good condition and is functioning properly (see Photo 2). The emergency spillway is in satisfactory condition except for a 15 foot deep depression in the approach channel which was part of a natural valley (see Plate 1) before the dam was constructed. Scattered small trees in the emergency spillway should be removed (see Photo 4). Some areas of dried grass on the right slope of the emergency spillway may need to be reseeded.

NAME OF DAM: MOTTS RUN

3.1.4 Reservoir Area: The slopes in the reservoir above the normal pool elevation are well vegetated with little or no erosion and sloughing. The temporarily exposed soil slopes below the normal pool elevation show evidences of erosion in its early stages. To prevent severe erosion, the reservoir should be refilled as soon as possible after repairs are completed to the riser. Debris was observed along the shoreline of the reservoir.

3.1.5 Downstream Channel: The outlet channels for the principal and emergency spillways are in good condition. There are several dead trees and other leaning trees with exposed roots in a thin soil mantle. Some clear seepage and slumping have occurred over bedrock on this steep hillside slope to the right of the impact basin (see Photo 3).

3.2 Evaluation

3.2.1 Dam: The erosion gullies on the downstream slope should be repaired. Trees and driftwood should be removed according to the regular maintenance schedule. The pipe outlets for the granular filter drain do not require any special attention.

3.2.2 Appurtenant Structures: The bent stems of the water supply gates and pond drain should be repaired without delay. The deep depression in the emergency spillway approach does not deter proper functioning of the emergency spillway but should be back filled during the dry season. The trees in the emergency spillway should be removed as part of annual maintenance.

3.2.3 Reservoir Area: It is assumed that the reservoir will be refilled soon after the repairs to the riser are made. The wood debris should be removed as part of annual maintenance. A staff gage should be installed to monitor reservoir levels above normal pool.

3.2.4 Downstream Channel: The dead and undermined trees on the steep slope of the hillside should be removed in the near future to prevent falling and blockage of the channel. The clear seepage and minor slumping on the lower slope of the hillside do not affect the efficiency of the channel.

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SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Operational procedures are generally discussed in paragraphs 1.2.8 and 2.3. There are no formal operating procedures for this dam. The slide gate, which can be used to drain the reservoir, is located on the upstream face of the riser. The three water supply gates can be used to withdraw water from different depths in the reservoir. Two gates are located on the left (northwest) side of the riser at elevations of 120.0 feet and 140.0 feet M.S.L. The third water supply gate is located on the right (southeast) side of the riser at elevation 100.0 feet M.S.L. The outflow from the dam enters the Rappahannock River and flows to the water supply intake for the City of Fredericksburg, about 3 miles downstream.

4.2 Maintenance of Dam: Maintenance of the dam is provided by the City of Fredericksburg.

4.3 Maintenance of Operating Facilities: Maintenance of the water supply gates and reservoir drain are provided by the City of Fredericksburg. All lift stems on the riser are severely bent; consequently, the stems are only partially operable. The stems are apparently bent because of an insufficient number and inadequate placement of stem guides, especially near the top of the riser (see Photo 1).

A report (Appendix V) entitled "Investigation of Riser at Motts Run Reservoir" was performed for the City of Fredericksburg by the firm of Hayes, Seay, Mattern and Mattern in November 1977. The purpose of this report was to investigate the construction joint between the riser and transition section, and to inspect the outfall and transition section for evidence of any condition which might threaten the integrity of the structure.

4.4 Warning System: At the present time, there is no formal warning system or evacuation plan in operation.

4.5 Evaluation: The City of Fredericksburg, at the time of this report, is contracting the work for repairs to the lift stems. This repair work should be completed without delay since the gates in their present condition are not fully operable.

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SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: Hydrologic and hydraulic design calculations for Motts Run Dam were not available for this report.
- 5.2 Hydrologic Records: No rainfall or stream flow records were available at the dam site.
- 5.3 Flood Experience: No high water mark information was available. However, according to the city engineer, the reservoir level has risen above the top of the riser but not above the emergency spillway crest.
- 5.4 Flood Potential: Performance of the reservoir by routing the Probable Maximum Flood (PMF), the 1/2 PMF, and the 100-year flood is shown in Table 5.1.

Outlet discharge capacity, reservoir area and storage capacity, and routing computations were all calculated as part of this report. Flood routings were started with the reservoir level at elevation 150.00 feet M.S.L.

- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Except for water supply, regulation of flow from the reservoir is automatic. Normal flow is maintained by two 2.5 by 5 foot openings on the two sides of the riser with a crest elevation of 150.0 feet M.S.L. Water entering these inlets flows through the dam in a 48 inch diameter reinforced concrete conduit. Water also flows past the dam through an ungated, vegetated, side-channel, emergency spillway in the event water in the reservoir rises above the spillway crest (elevation 156.0 feet M.S.L.).

- 5.6 Overtopping Potential: The probable rise in reservoir and other pertinent information on the reservoir performance for various hydrographs are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	100 Year	Hydrographs		PMF
			1/2 PMF	PMF	
Peak flow, c.f.s.					
Inflow	-	4958	12,998	25,995	
Outflow	-	1646	11,839	24,490	
Peak elev., ft. M.S.L.	150.0	157.9	162.1	165.2	
Emergency spillway					
Depth of flow, ft. (a)	-	0.7	2.9	4.8	
Avg. velocity, f.p.s.	-	4.6	9.6	12.2	
Duration of flow, hrs.	-	11	18	20	
Non-overflow section					
Depth of flow, ft.	-	-	-	0.2	
Average velocity, f.p.s.	-	-	-	1.1	
Duration of overtopping, hrs.	-	-	-	2.4	
Tailwater elev., ft. M.S.L.	71.6	-	-	-	

(a) Depth at control section, not including velocity head.

5.7 Reservoir Emptying Potential: The reservoir, with a discharge of 345 c.f.s. at elevation 150.0 feet M.S.L., can be drawn down in approximately 8 days neglecting inflow.

5.8 Evaluation: In accordance with COE criteria for an "intermediate" size-"high" hazard dam, the spillway should pass a spillway design flood (SDF) equal to the PMF. As shown in Table 5.1, the spillway of Motts Run Dam will only pass 96 percent of the PMF. The spillway is therefore adjudged as inadequate but not seriously inadequate.

Conclusions pertain to present day conditions and the effect of future development on the hydrology has not been considered.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: No information was available regarding the foundation material. From visual observations, however, the soils apparently consist of silt, sand, gravel, and rock fragments at the bottom of the valley. There is clayey and sandy silt with rock fragments on the slopes. The soil cover ranges from 3 to 8 feet over steeply jointed granite, schist, gneiss, and granodiorite of uncertain age (based on the state geologic maps). The dip of the schist and gneiss in the left abutment is 30° to 60° with a N-S strike. The cutoff trench had been designed to be excavated to the maximum rippable depth in bedrock which appears to be a firm foundation.

6.2 Stability Analysis

6.2.1 Visual Observations: During the inspection, no evidence of instability was observed in the embankment, cut slopes for the emergency spillway, or the concrete structures. There were some erosion gullies in the lower portion of the downstream slope. There was no noticeable seepage from the embankment. The flow of water from the two pipes draining the granular filter was measured at 0.5 g.p.m. from one and a trace amount from the other.

The clear seepage and slumping in the lower part of the hillside near the downstream channel do not affect the toe of the dam.

6.2.2 Design Data: No stability calculations were available.

6.2.3 Operating Records: The structure has no instrumentation to determine stability. There are no operating records or annual maintenance inspection reports available.

6.2.4 Post-Construction Changes: No alterations to the dam were apparent since it was constructed. At the time of inspection, the water level was 25 feet below the normal pool elevation due to repairs to be made to the riser.

6.2.5 Seismic Stability: Motts Run Dam is located at the line of demarcation between Seismic Zones 1 and 2. Therefore, the dam is considered to have no hazard from earthquakes

NAME OF DAM: MOTTS RUN

according to the Recommended Guidelines for Safety Inspection of Dams, provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: There do not appear to be any significant deficient conditions which would affect the stability of the dam. The side slopes of the embankments (4:1) are not as steep as those typically used for homogeneous earth dams (3:1 or 2.5:1) and provide greater stability. However, a complete assessment of seepage can not be made until the reservoir level is returned to normal pool.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The dam will not pass the PMF without overtopping and according to COE criteria, the spillway is adjudged as inadequate but not seriously inadequate. Since design hydrology and hydraulics were not available, all hydrologic and hydraulic calculations were computed as part of this report. No stability, foundation, or soil reports were available. However, no evidence of seepage or embankment distress was observed.

The November 1977 report on the visual inspection of the riser (Appendix V) indicates deterioration of the interior of the riser at the construction joint between the riser and transition section. The report recommends that the exterior of the riser at this location be examined by dewatering the reservoir and effecting any necessary repairs.

The dam is generally in good condition with the exception of the above-mentioned items.

7.2 Recommended Remedial Measures: The inspection revealed certain preventative maintenance items which should be scheduled as part of an annual maintenance program. These are:

- 1) Remove any large debris in the reservoir area to prevent clogging of the intakes.
- 2) Gate stems on the riser should be repaired (scheduled for completion at the time of this report).
- 3) Fill and seed all erosion gullies and bare areas on the downstream embankment.
- 4) Remove all trees on the embankment at its junction with the abutments, and along the downstream toe and in the emergency spillway.
- 5) Remove undercut trees on the steep hillside along the downstream channel to prevent channel obstruction.
- 6) Install a staff gage to monitor reservoir levels above normal pool.

APPENDIX I

PLATES

CONTENTS

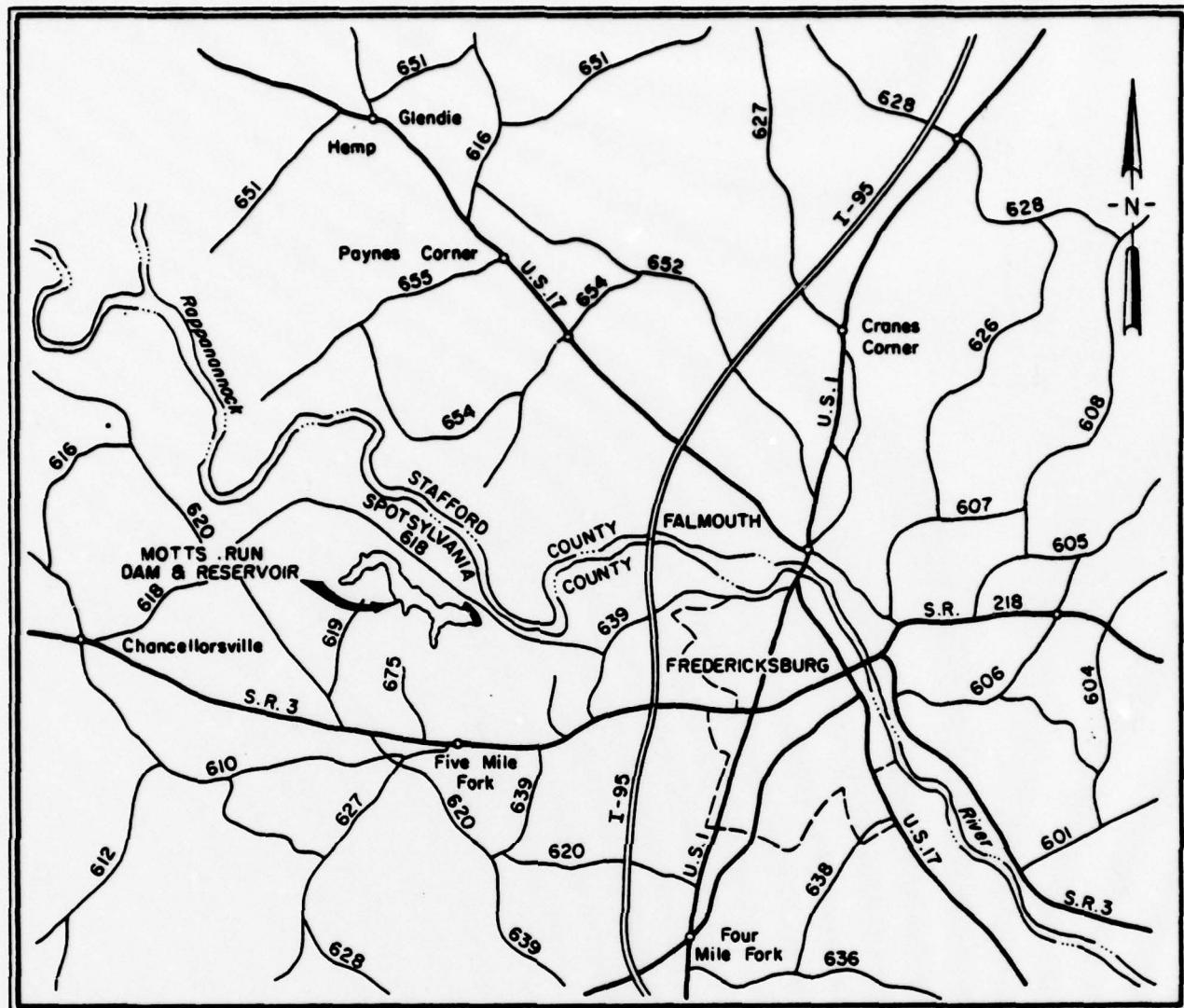
Location Plan

Plate 1: Plan of Dam and Emergency Spillway

Plate 2: Typical Section of Dam

Plate 3: Profile of Dam and Typical Section

NAME OF DAM: MOTTS RUN



SCALE

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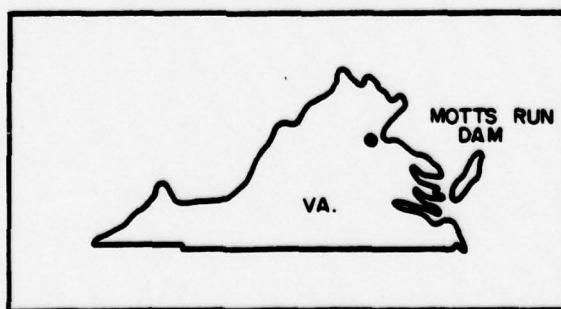
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10,000

20,000

30,000

FEET



LOCATION PLAN
MOTTS RUN DAM



Aug 22 33
No. 34000 in Nat. George Department

EMERGENCY SPILLWAT!

*Foundation of India to be Shared
Between and Shared by European States.*

EL ELEVATION 1960

Sold out to me
Cleared and Graded

-Borrow Area

Area Used to be Crossed by Gravel

Werner Pool Collection 1229

— *Encyclopædia Britannica* 1956

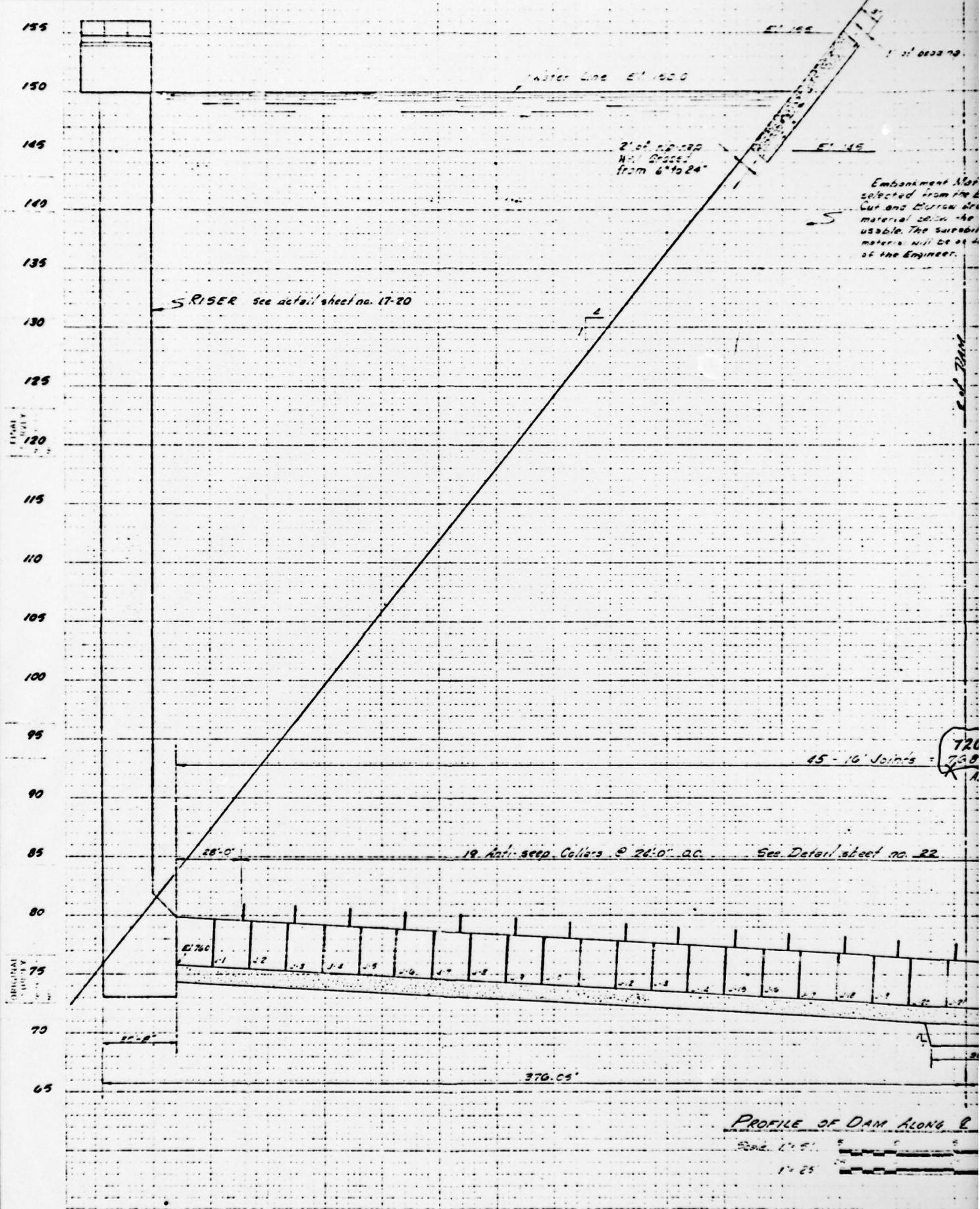
—George Washington—

Design High water

100 200 300 400

PLATE 1

**CITY OF FREDERICKSBURG
MOTTS RUN RESERVOIR
PLAN - EARTH DAM
AND EMERGENCY SPILLWAY**



See Sheet 12
for Grading

shall be
Emergency Spillway
In general, all
soil will be
by or any particular
a sole discretion

Area under Dam, Emergency Spillway
and portion of Borrow Area needed
shall be cleared and grubbed.

2. The reservoir shall be cleared to
Elev. 152.0. The clearing shall be
Class A.

3. Sufficient selected top-soil shall
be stock piled and placed at a
minimum of 9 inches on the Dam
faces and Emergency Spillway side
slopes.

4. The Emergency Spillway Bottom shall
be graded smooth. Any low points shall
be filled w/tn select material and
compacted.

5. The Dam Faces, Emergency Spillway
side slopes and Bottom shall be
Seeded, Limed, Fertilized and Mulched.

6. The Borrow Area shall be graded such
that there is no ponding of water. The
entire Borrow Area that lies above the
Normal Foot Elevation shall be Seeded,
Limed, Fertilized and Mulched.

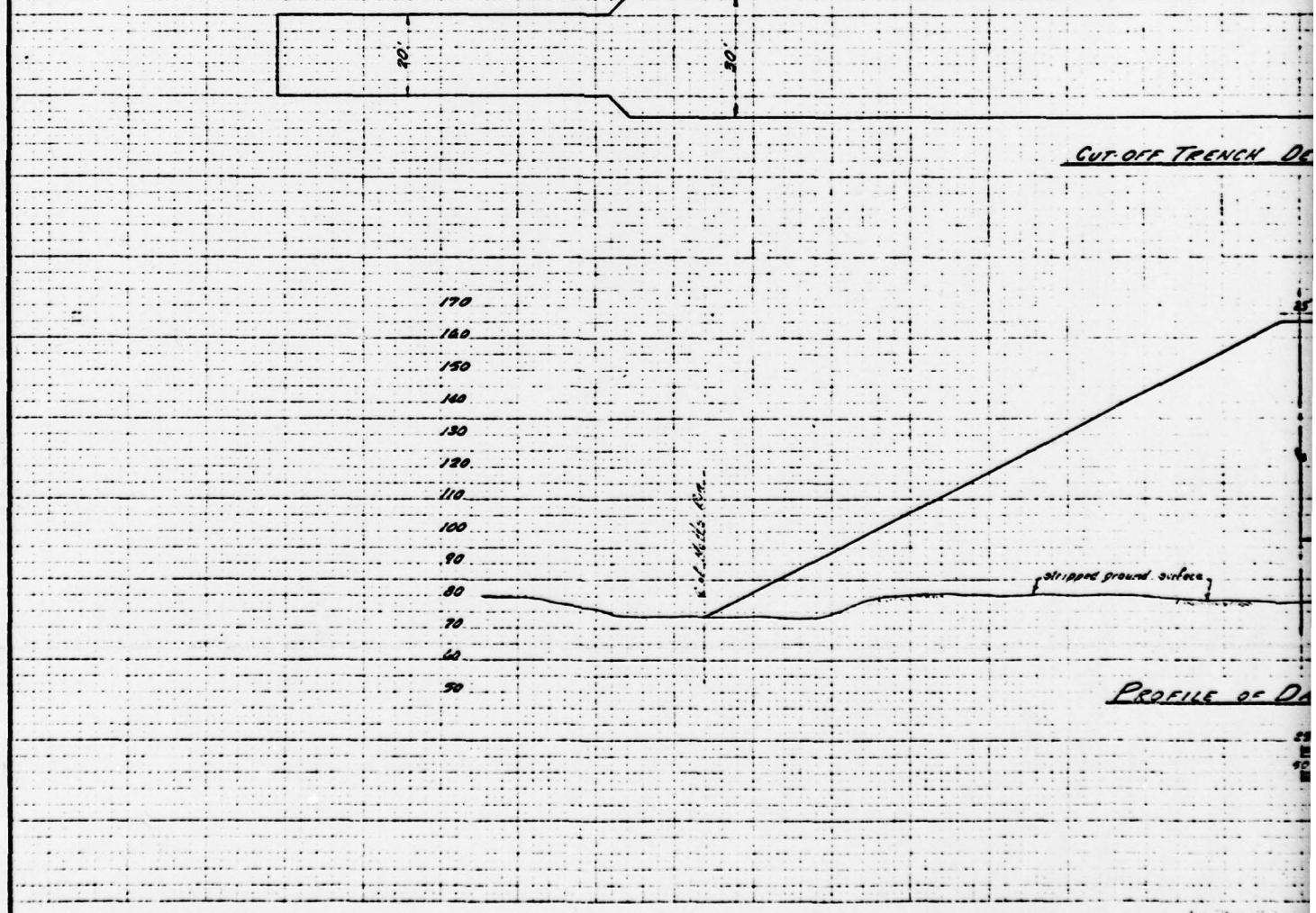
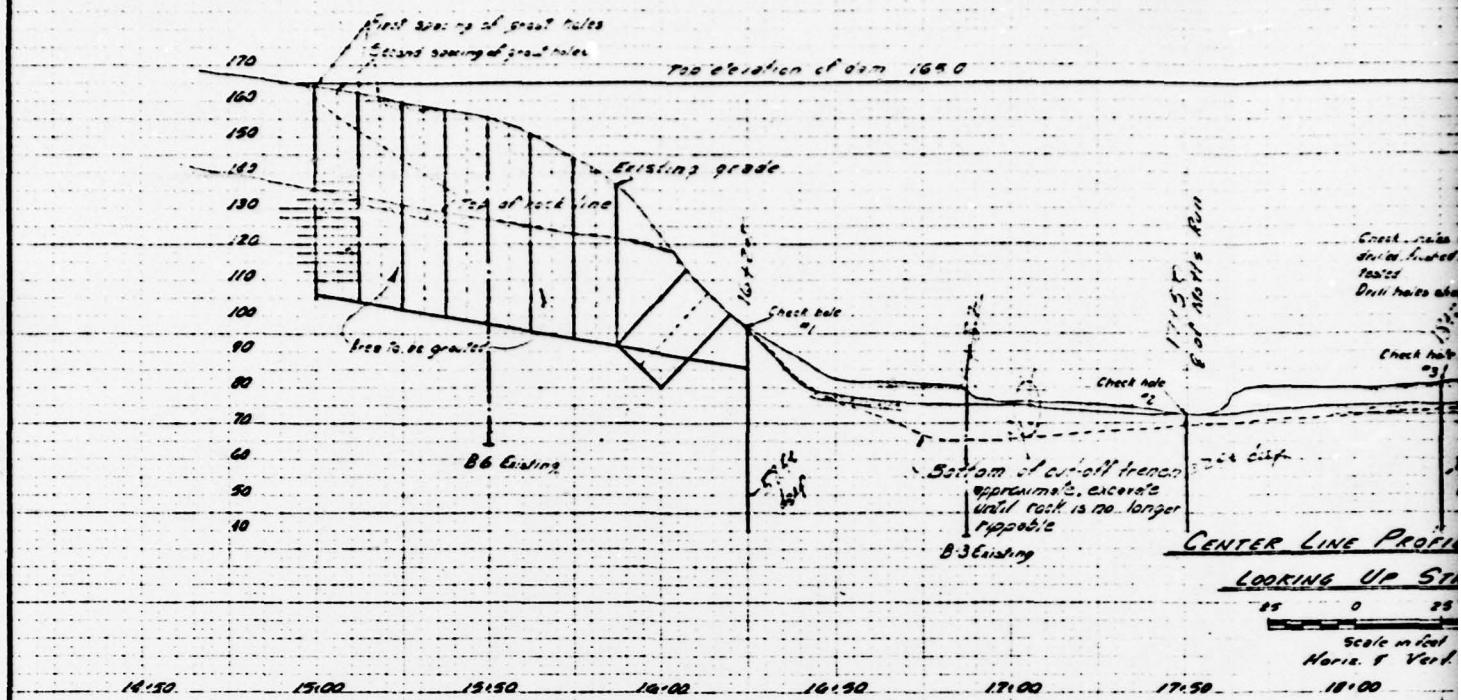
7. The intersections of Dam faces at the
outlets shall be shaped as directed
by the Engineer.

8. Side slopes of the stream diversion
channel under the Dam shall be cut
back to a slope no steeper than 1
vertical to 3 horizontal.

9. The Cutoff Trench Bottom shown on
the plans is approximate. The bottom
shall be carried down until the rock
becomes unripable.

10. All areas under the embankment shall be
stripped to a depth sufficient to insure
that all roots and organic matter is
removed.

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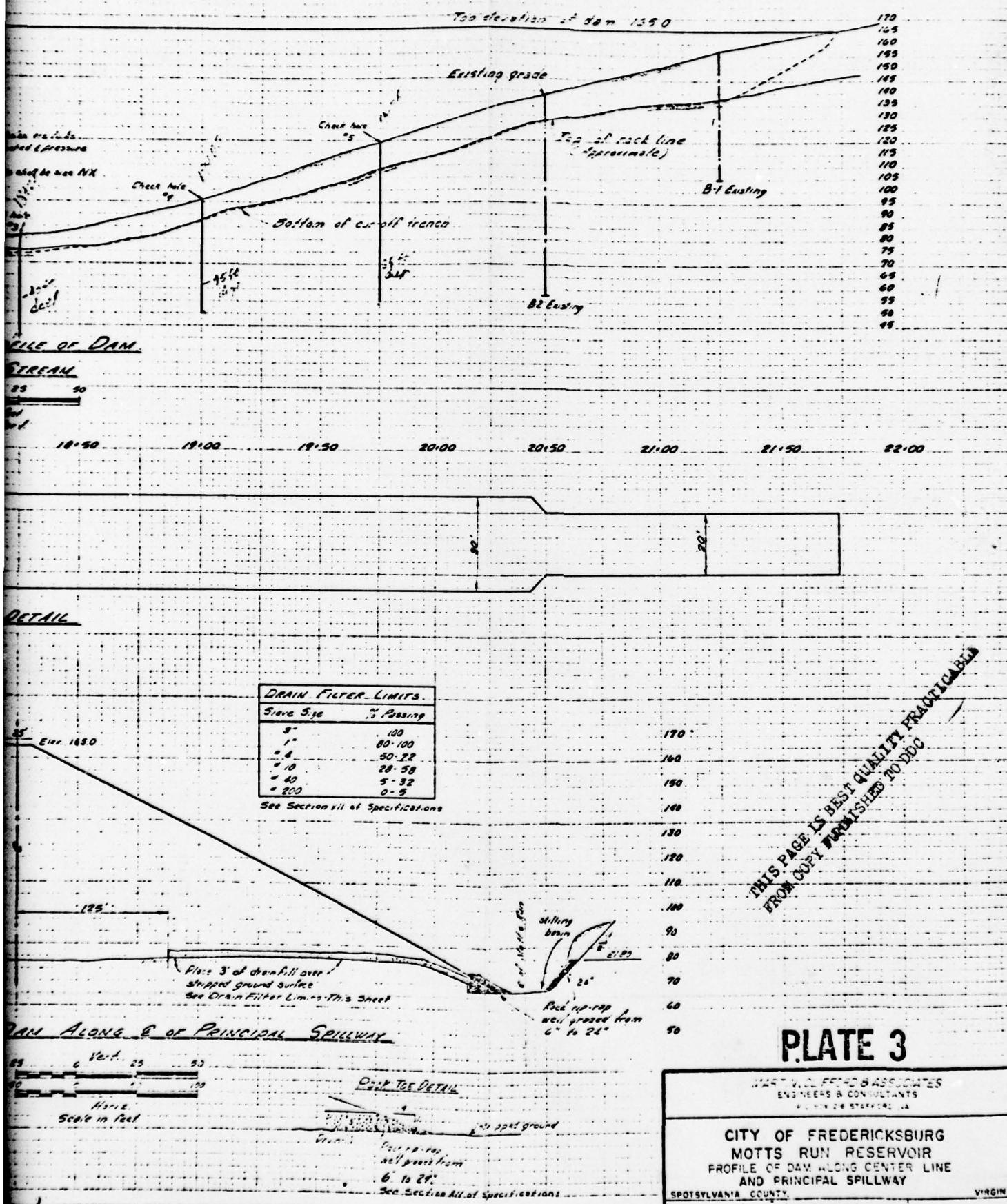


PLATE 3

12457 V. COLEFF & ASSOCIATES
ENGINEERS & CONSULTANTS
P. O. BOX 265, ST. LOUIS, MO.

CITY OF FREDERICKSBURG
MOTTS RUN RESERVOIR
PROFILE OF DAM ALONG CENTER LINE
AND PRINCIPAL SPILLWAY
SPOTSYLVANIA COUNTY

VIRGINIA

2

APPENDIX II

PHOTOGRAPHS

CONTENTS

- Photo 1: Upstream View of Riser Showing Trash Racks and Bent Gate Stems**
- Photo 2: Impact Basin, Baffle Wall, and Tailwater**
- Photo 3: River Road Culvert Located Immediately Downstream From Impact Basin**
- Photo 4: View Across Emergency Spillway Showing Scattered Tree Growth**

Note: Photographs were taken on 30 November 1978.

NAME OF DAM: MOTTS RUN

MOTTS RUN DAM

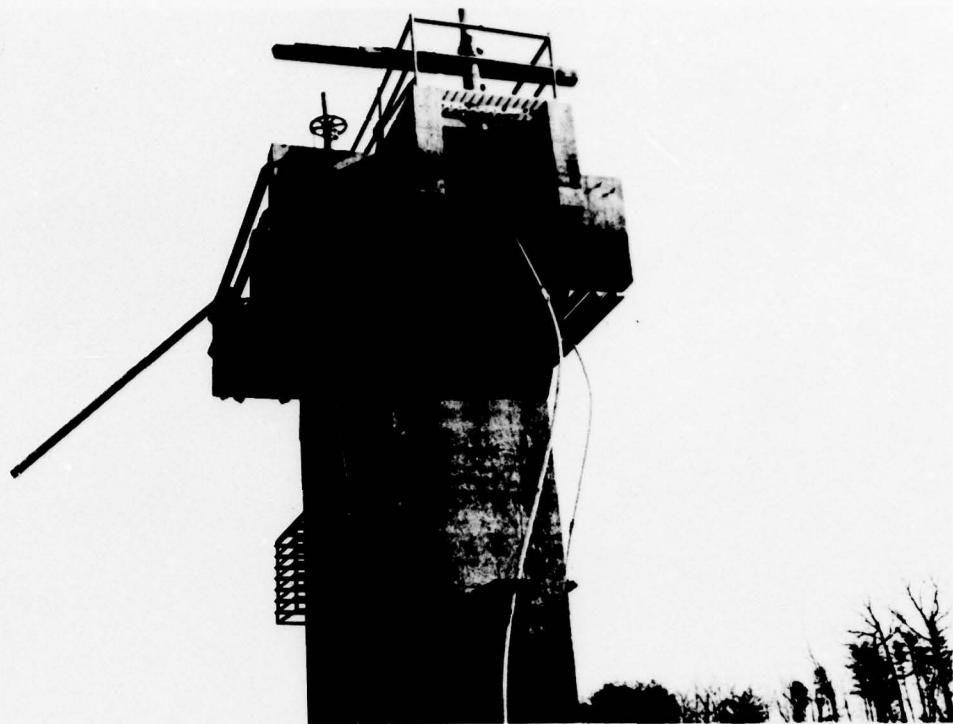


PHOTO 1. Upstream View of Riser Showing Trash Racks and Bent Gate Stems



PHOTO 2. Impact Basin, Baffle Wall and Tailwater

MOTTS RUN DAM



PHOTO 3. River Road Culvert Located Immediately Downstream From Impact Basin



PHOTO 4. View Across Emergency Spillway Showing Scattered Tree Growth

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1.

Name of Dam Motts Run County Spotsylvania State Virginia Coordinates Lat. 3818.8
Long. 7732.6

Date Inspection 30 November 1978 Weather Warm, Sunny Temperature 60°F.

Pool Elevation at Time of Inspection 125.2 ft. M.S.L. Tailwater at Time of Inspection 71.6 ft. M.S.L.

Inspection Personnel:

Michael Baker, Jr., Inc.:

T. W. Smith
W. L. Sheaffer
T. J. Dougan

EMBANKMENT		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VISUAL EXAMINATION OF			
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE		No movement or cracks were observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	III-2	There is minor slumping adjacent to a clear seep at the base of the right toe. Some erosion exists in several gullies and a path on the lower downstream slope. These eroded areas act as small watercourses for surface runoff.	The erosion gullies and path should be filled and seeded.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST		Good	
RIPRAP FAILURES		Riprap at normal pool level was in overall good condition except for a few areas of uneven coverage and some concentrations of small sizes. Scattered small trees and bushes are growing at the top of the riprap. Wood debris was also observed. The base of the riprap was approximately 20 ft. above the pool elevation.	There is an adequate rock coverage. The small trees, bushes, and driftwood should be removed.
SLOPES		The 4:1 grass covered upstream and downstream slopes are in good condition. The slope below the riprap to the water level is mostly bare with scattered tree driftwood and trash due to low reservoir level. There are some small trees growing in the downstream riprap toe drain.	Driftwood and trash should be removed from the upstream slope. The trees should be removed from the toe drain.

EMBANKMENT

Name of Dam: MOTTS RUN

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONSTRUCTION MATERIALS	III AND ABUTMENT, SPILLWAY AND DAM	<p>According to the plans, the embankment was apparently constructed of unzoned, earth materials. The soils observed on the surface consisted principally of silt, sand, and small rock fragments with mica flakes. In the lower part of the exposed upstream slope, there is a layer of red, stiff, silty clay overlying brown, wet, loose sand and silt at the waterline. The embankment appears to be well-compacted.</p>	<p>The embankment appears to be stable, and the bare slope above the lake level has not eroded.</p>
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM		<p>The junction of the dam at both abutments appears to be a good contact. There is a thin (3 ft.) soil cover on both sides consisting of damp, micaceous, sandy silt with rock fragments overlying schist dipping 30°-60°E with an approximate N-S strike. The schist is soft to medium-hard with some gneiss and steep joints. The rock is (varicolored) and weathered in exposures. The slope gutters at the abutments are unpaved with vegetation (including small trees) in some areas.</p>	<p>The trees in the slope gutters should be removed.</p>
ANY NOTICEABLE SEEPAGE		<p>Seepage was not observed from the embankment. There is some clear seepage at the base of the hillside which has slumped slightly on the right side in the vicinity of the downstream dam toe. Some trees on the hillside in this area are leaning toward the stream.</p>	<p>Removal of the trees is recommended before they fall into the stream channel.</p>
STAFF GAGE AND RECORDER			None

EMBANKMENT

Name of Dam: MOTTS RUN

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
DRAINS	<p>There is a 3 ft. thick, granular filter drain at the bottom of the embankment approximately 250 ft. wide near the downstream toe which outlets into the rock riprap. No uncontrolled seepage was observed. There is a 12 in. drainpipe on each side of the principal spillway outlet. The right drainpipe conducts water estimated at 0.5 g.p.m. with some red algae deposit. The left drainpipe has a trace of flow. The pipe drainage is apparently from the filter drain.</p>	
FOUNDATION	<p>Boring logs were not included in the plans. The soil apparently consists of silt, sand, gravel, and rock fragments at the bottom of the valley. There is clayey and sandy silt with rock fragments on the slopes. The soil cover ranges from 3 to 8 ft. over granite schist, gneiss, and granodiorite of uncertain age. The bedrock is apparently firm. The cutoff trench was designed to be excavated into rock to the maximum ripable depth. This information was obtained from field observations at the site and the state geologic map.</p>	

Name of Dam: MOTTS RUN

OUTLET WORKS

VISUAL EXAMINATION OF
OBSERVATIONS

CRACKING AND SPALLING OF
CONCRETE SURFACES IN
OUTLET CONDUIT

No unusual spalling or cracking of the outlet conduit was observed.

REMARKS OR RECOMMENDATIONS

INTAKE STRUCTURE

The intake structure consists of a reinforced concrete riser. All stems on the riser for the water supply gates and pond drain are severely bent. Exterior concrete is in good condition.

The City of Fredricksburg is presently attempting to repair the stems and gates.

III-5

OUTLET STRUCTURE

The outlet structure is an impact basin 26 ft. long and 19 ft. wide consisting of a baffle wall and end sill. The outlet pipe (42 in. dia. R.C.P.) was flowing about 2/3 full. There is a 12 in. drainpipe on either side of the outlet with minor flow as reported in DRAINS.

OUTLET CHANNEL The outlet channel primarily has a bedrock streambed with a 45° bend to the left. There is a hard rock exposure in the steep hillside on the right side of the channel. It exits through a 100 in. dia. C.M.P. under a highway. The head walls on the road crossing consist of sandbags. About 300 ft. beyond the bridge, the stream enters the Rappahannock River.

EMERGENCY GATE

The emergency gate is located on the riser and can be used to drain the reservoir. At the time of inspection, the gate was inoperable and partially open.

The gate is under contract for repair.

Name of Dam: MOTTS RUN

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	Control section is at elevation 156.0 ft. M.S.L. The section is approximately 400 ft. wide and 300 to 400 ft. long.	
APPROACH CHANNEL	Approach channel (600 ft. long) is relatively flat in sandy silt. There is a depression approximately 100 ft. x 50 ft. x 15 ft. deep in the soil. There is 0.5 ft. of water in the lower end, with scattered boulders and debris. The depression was a partially filled gully. There are scattered small trees. Photo 4 shows the spillway.	It is recommended that the depression be filled with compacted earth or rockfill to prevent erosion. The trees should be removed.
DISCHARGE CHANNEL	The discharge channel has about a 1.5% exit slope and discharge beyond the right abutment of the dam downstream into a wooded stream through a culvert and into the nearby Rappahannock River.	
BRIDGE AND PIERS	None	
SLOPES	The slopes are cut at a 4:1 ratio in brown, damp, sandy silt and rock fragments with mica flakes. Some weathered gneiss and schist occurs in a ridge at a higher elevation on the right side; otherwise, the bedrock appears to be covered by a thick soil mantle. The slopes are generally well-covered by grass, except for some brown areas on the upper slope on the right side. A few small trees are growing on the slope near the lake.	The trees should be removed.
WET AREAS	There is a shallow wet area (50 ft. x 100 ft.) just downstream from the projected centerline of the dam caused by dam seepage from the toe of the right slope. Reeds and small trees are growing in the small depression.	The trees should be removed.

Name of Dam: MOTTS RUN INSTRUMENTATION

<u>VISUAL EXAMINATION</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

RESERVOIR

Name of Dam: MOTTS RUNVISUAL EXAMINATION OF OBSERVATIONS

SLOPES The slopes of the reservoir consist of silt and sand with rock fragments and mica flakes. There are also sandy and clayey silt layers. There is no significant erosion in the exposed slopes. There is scattered wood debris. A few small outcrops of bedrock appear on the slopes. The upper slopes are steeper and wooded.

REMARKS OR RECOMMENDATIONS

Wood debris should be removed.

SEDIMENTATION

There is no measurable sedimentation.

Name of Dam:	MOTTS RUN	DOWNSTREAM CHANNEL
VISUAL EXAMINATION OF		OBSERVATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)		REMARKS OR RECOMMENDATIONS
SLOPES	The road culvert immediately downstream shows signs of past erosion and has been protected with sandbag type head walls. Otherwise, the downstream channel is clear of obstructions to the Rappahannock River.	It is recommended that the dead trees and those with an unstable root condition be removed to protect the channel from future blockage.
APPROXIMATE NO. OF HOMES AND POPULATION	There are no homes or buildings located between the dam and the Rappahannock River. However, the river flows through Fredericksburg, which has a population of about 15,000, about 4 mi. downstream.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA

**CHECK LIST
ENGINEERING DATA
DESIGN. CONSTRUCTION. OPERATION**

Name of Dam: WOTTS RUN

TRIM

PLAN OF DAM A Plan of Dam as found in the as-built drawings is included in this report as Plate 1.

REGIONAL VICINITY MAP

CONSTRUCTION HISTORY Construction information was obtained from the **Fredericksburg City Engineer**. The earthwork contractor was **Moore, Kelly and Reddish, Inc.** The contractor for the concrete structures was **Bailey and Associates**. The construction was completed in 1971.

IV-1

OUTLETS - PLAN.

DRAFT 10

CONSTRAINTS and **CONSTRAINTS** are included in the as-built drawings for this report.

— DISCHARGE RATINGS None were available for this vendor

RAINFALL/RESERVOIR RECORDS None were available at the dam site.

Name of Dam: MOTTS RUN

ITEM	REMARKS
------	---------

DESIGN REPORTS No design reports were available for this inspection report.

GEOLOGY REPORTS No geologic reports were available for this report.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

IV-2

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

POST-CONSTRUCTION SURVEYS OF DAM No known post-construction surveys were available for review.

BORROW SOURCES Embankment material was obtained from the excavation of the emergency spillway and a borrow area in an adjacent hill on the right side of the spillway.

Name of Dam: MOTTS RUN

<u>ITEM</u>	<u>REMARKS</u>
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MONITORING SYSTEMS None

MODIFICATIONS Design modifications are indicated on as-built drawings.

HIGH POOL RECORDS No formal records are available; however, the water level has risen above the riser crest (elevation 150 ft. M.S.L.) according to the city engineer. It is not known whether the emergency spillway has been activated.

POST-CONSTRUCTION ENGINEERING A report of the condition of the riser is included in this report as Appendix V.
STUDIES AND REPORTS

PRIOR ACCIDENTS OR FAILURE OF DAM There were no known prior accidents or failures.
DESCRIPTION REPORTS

MAINTENANCE No formal maintenance and inspection, or operation records are kept.
OPERATION RECORDS

Name of Dam: MOTTS RUN

<u>ITEM</u>	<u>REMARKS</u>
SPILLWAY PLAN, SECTIONS and DETAILS	are contained in the as-built drawings.

OPERATING EQUIPMENT
PLANS & DETAILS are shown in the as-built drawings.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 10.3 sq.mi. (generally wooded)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 150.0 ft. M.S.L.
(4119 ac.-ft.)

ELEVATION TOP EMERGENCY SPILLWAY CREST
(STORAGE CAPACITY): 156.0 ft. M.S.L. (5138 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: 162.0 ft. M.S.L.

ELEVATION TOP DAM: 165.0 ft. M.S.L.

CREST: Emergency Spillway

- a. Elevation 156.0 ft. M.S.L.
- b. Type Earth, side-channel with vegetative cover
- c. Width 400 ft.
- d. Length Approximately 600 ft. approach length
- e. Location Spillover Outside right abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type R.C. drop-inlet riser with conduit emptying into impact basin
- b. Location Riser in reservoir about middle of embankment
- c. Entrance inverts 150 ft. M.S.L. (normal pool)
- d. Exit inverts 68.5 ft. M.S.L. conduit and end sill invert
- e. Emergency draindown facilities 3 ft. slide gate on riser at invert elevation 76.0 ft. M.S.L.

HYDROMETEOROLOGICAL GAGES: None at dam site

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

Name of Dam: MOTTS RUN

APPENDIX V

INVESTIGATION OF RISER AT MOTTS RUN RESERVOIR

Investigation of Riser
Motts Run Reservoir
City of Fredericksburg, Virginia
A&E Commission No. 3994
30 November 1977

1. Introduction

Pursuant to your request, Mr. Edward L. Janney of Hayes, Seay, Mattern and Mattern made an investigation of the existing riser and transition section leading to the outfall pipe at the Motts Run Reservoir, on 9 November 1977. Mr. M. A. Moncure, Utilities Engineer for the City of Fredericksburg, assisted in the investigation, which consisted of visual observation and limited field measurements; a number of photographs were also made. The investigation was limited to an examination of the construction joint between the riser and the transition section, and an inspection of the outfall and transition section, to determine if there is evidence of any condition that would threaten the integrity of the structure.

2. Observations

The interior surface of the riser is covered with slime. The slime was removed in several locations to permit examination of the concrete surface. At all locations where the concrete was exposed, it appeared to be in good condition. There were no visible cracks or indications of honeycomb or unsound concrete.

Two major leaks were observed at the construction joint between the riser and the transition section to which the outfall pipe is connected. A larger, triangular spalled area, through which there is a flow of approximately 100 gallons per minute, is about two feet long by six inches wide and is centrally located between the east and west walls of the riser. Through a smaller spalled area at the west wall of the riser, about 6 inches long by 6 inches wide, there is a flow of approximately 15 gallons per minute. A third leak at the construction joint was discovered after slime was removed from the east wall. Its flow rate is about one gallon per hour.

At the larger spalled areas the water has eroded away the inside face of the construction joint to expose aggregate and reinforcing steel. At several locations in the spalled areas, approximately 80 percent of the surface area of the reinforcement has been exposed. Several reinforcing bars show signs of corrosion.

Attached hereto are a sketch showing the locations of the leaks and photographs of the exterior and interior of the riser. The photographs of the riser interior show the construction joint at the top of the transition section where the leakage occurs. Encrustations and damaged concrete can be seen.

The exterior surface of the upper 25'-0" of the riser appeared to be in good condition. The concrete appeared to be sound and free of cracks and honeycomb. The lower portion (approximately 50'-0") was below the reservoir surface and could not be inspected from the exterior.

3. Evaluation of Findings

There is some evidence of excessive stress at the construction joint between the riser and transition section to which the outfall pipe connects. It is possible that rotation of the transition section may have caused excessive compressive stress near the inside surface at the construction joint, which induced spalling of the concrete. It is likely that enough joint movement has occurred to render the waterstop ineffective.

4. Recommendations

The exterior of the riser, particularly at the construction joint between the riser and the transition section, should be carefully examined for evidence of rotation and/or settlement. The examination and subsequent repairs will not be possible without dewatering the reservoir; it is therefore recommended that the reservoir be drained. If the 36 inch diameter gate is opened completely and other gates are closed, our calculations indicate that the reservoir could be drained in approximately five days. These calculations are based upon

an initial pool level at elevation 133.0, with free discharge at elevation 68.5 feet and a recharge rate of 15 MGD. The capacity of the culvert under State Route 618 is assumed to be 400 cfs.

This rate of drainage would represent a rapid drawdown condition, however, and could cause instability in the upstream part of the dam as a result of pore-water pressure. (Rapid drawdown is defined as a drawdown rate of six inches or more per day.) Inasmuch as the upstream slope is as flat at 4:1, it would appear that stability under a rapid drawdown condition might not be a problem; however, before proceeding, the original design calculations should be checked for this condition, or, if they are not available, soil tests should be made and the stability for this condition should be calculated. If the calculations indicate that rapid drawdown is permissible and that it is possible to control the drawdown rate with the existing defective drain gate, it is recommended that the reservoir be drained over a two to three week period.

Records indicate that the period from March 2, 1971, to June 1, 1971, was required to fill the reservoir initially. However, records also indicate that, using average rainfall figures, about 180 days (6 months) would be needed to fill the reservoir. It is therefore recommended that the reservoir be drained and that the necessary repairs be made following the fall of 1978.

After examination of the exterior, a specialized contractor should be on-site, ready to make repairs to the construction joint and structure as required. In our opinion, it is essential that the riser be repaired as soon as practicable to prevent further deterioration of the concrete and exposed reinforcing in the areas where leakage has been observed. It appears that it will be possible to repair the structure by constructing a reinforced concrete collar around the construction joint on the outside and repairing the spalled sections on the

inside with an epoxy mortar. However, repair procedures can not be finalized until there is an opportunity to examine the outside surface of the riser.

While the reservoir is drained, the operating mechanisms for the gates should be repaired as recommended by the City Engineer.

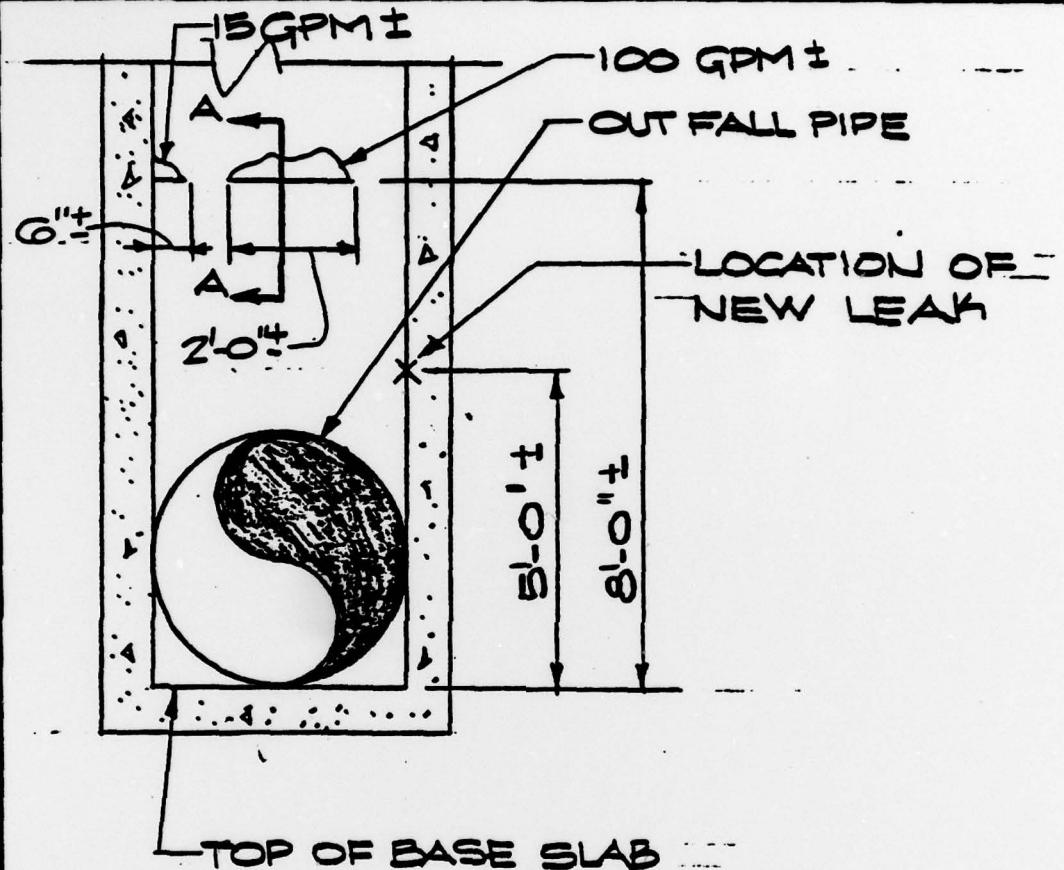
PROJECT MOTTS RUN RESERVOAR
CITY OF FREDERICKSBURG
TYPE FIELD INVESTIGATION
CONTENTS SECTION OF RISER,
SECTION A-A

Kayes, Seay, Mattern and Mattern
ARCHITECTS • ENGINEERS • PLANNERS

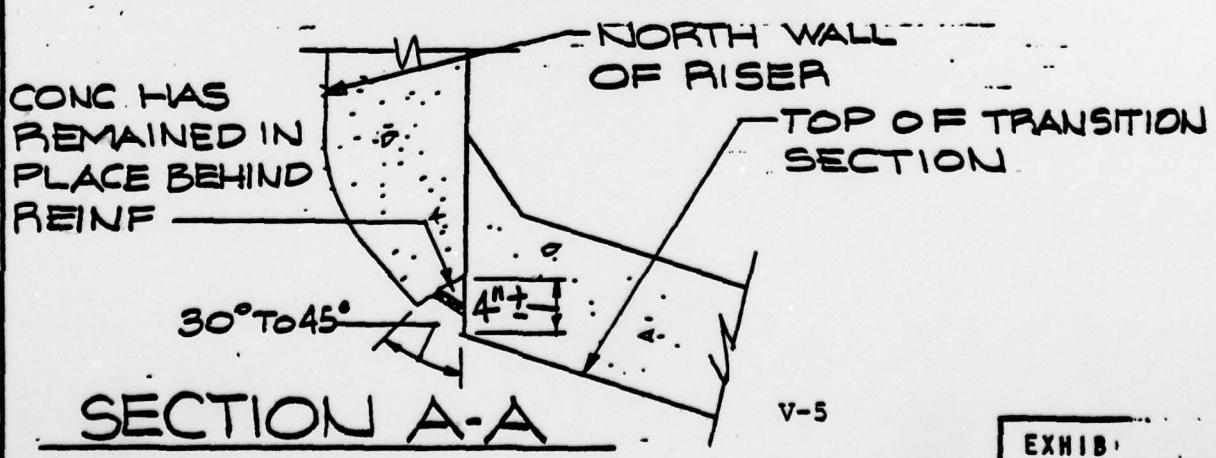
DATE 11/9/77 COMM NO. 3994

PREL. _____ FINAL _____ SHEET NO. _____

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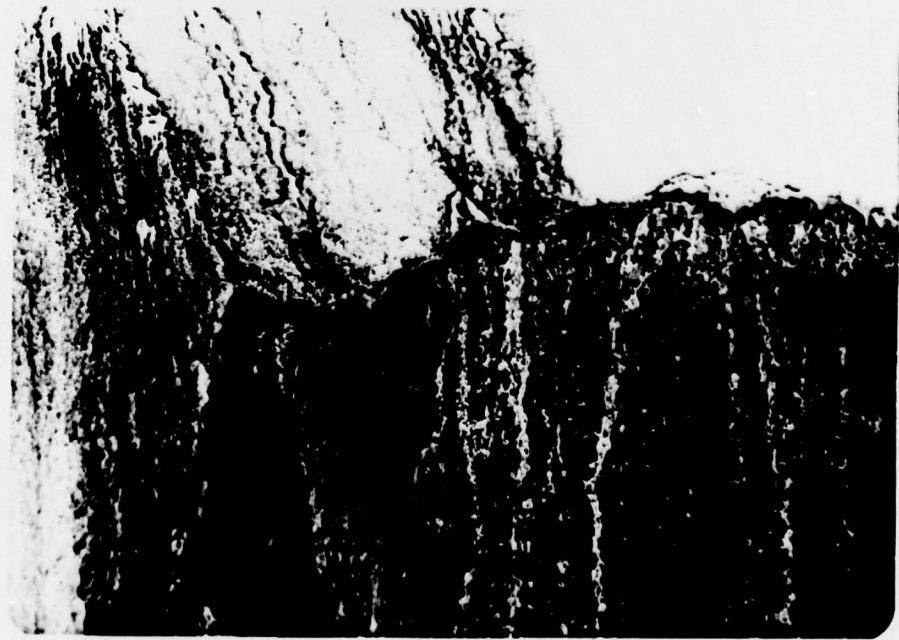


SECTION OF RISER LOOKING NORTH

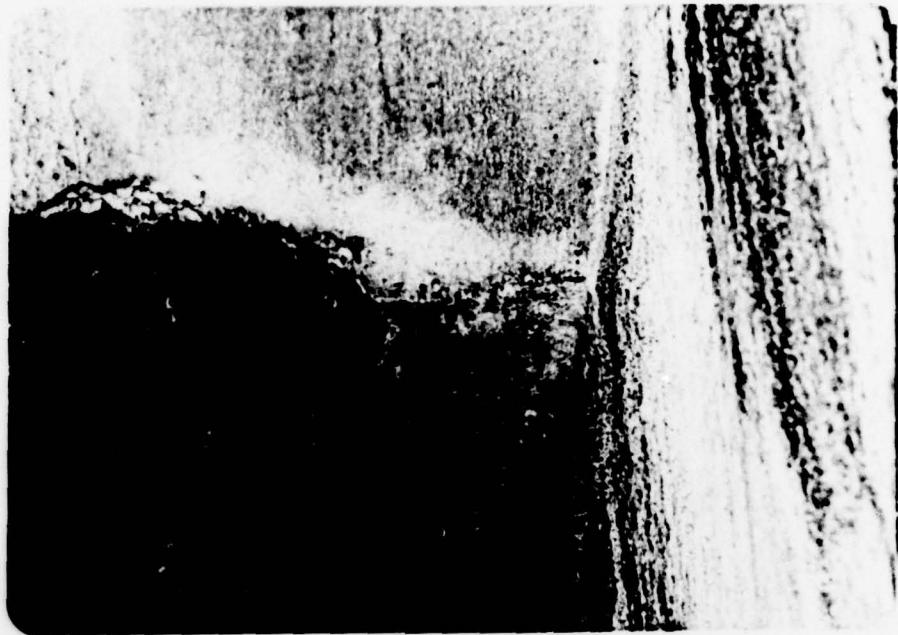




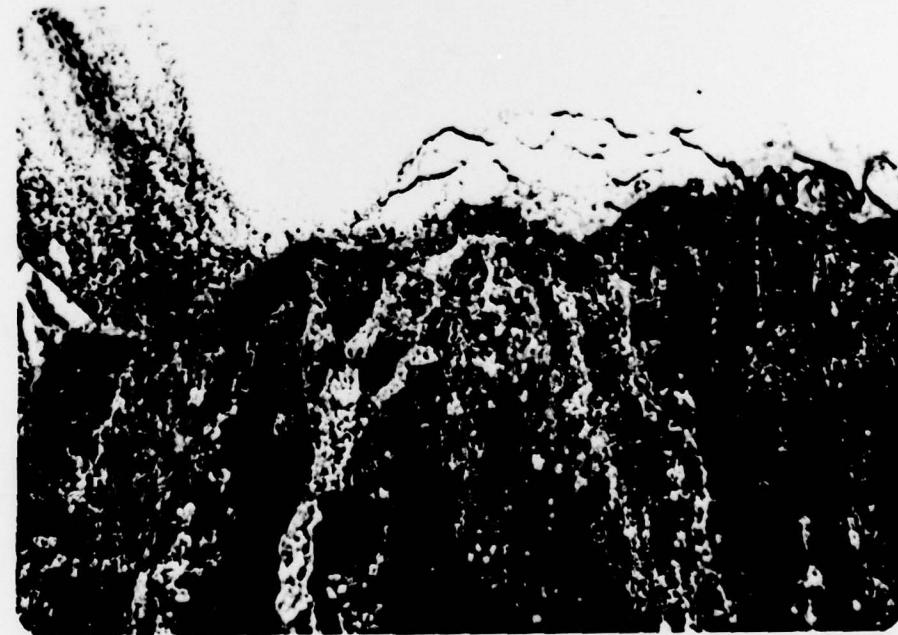
EXTERIOR VIEW OF INTAKE TOWER



LEFT SIDE OF CONSTRUCTION JOINT



RIGHT SIDE OF CONSTRUCTION JOINT



CLOSE-UP VIEW OF CONSTRUCTION JOINT

APPENDIX VI

REFERENCES

REFERENCES

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NAME OF DAM: MOTTS RUN

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NAME OF DAM: MOTT'S RUN

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